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LOCATION-SPECIFIC IN-VEHICLE FREQUENCY TUNING DATA

Rodric C. Fan

BACKGROUND

1. Field of the invention

Embodiments pertain to in-vehicle radio frequency signal reception, and more particularly to providing signal tuning information for signal reception areas in which the vehicle is located.

2. Related art

Many motor vehicles (e.g., automobiles, trucks) are equipped with radio receivers that receive radio signals from commercial radio broadcast stations (e.g., AM, FM). These radio receivers are typically equipped with means (e.g., conventional pushbuttons located on the receiver's front panel) that allow a radio listener to select one of several preselected radio frequencies for tuning and listening to content carried by the signal. At a particular geographic position, therefore, the listener may choose among several preselected commercial radio broadcast stations whose radio signal reception areas encompass the receiver's position. FIG. 1 illustrates motor vehicle 10 operating within reception area 12 of a signal broadcast by commercial broadcast transmitter 14. When in reception area 12, an occupant of vehicle 10 presses a pushbutton to select the signal frequency of transmitter 14.

Since the number of available preselected tuning frequencies is typically limited, when a motor vehicle is moved outside the signal reception areas of the broadcast stations whose frequencies have been preselected by the listener, the listener must then manually select broadcast signal frequencies for new signal reception areas. As illustrated in FIG. 1, for

example, as vehicle 10 travels (depicted by the arrow) beyond reception area 12, the listener must find (e.g., manually tune or use a frequency scanning feature) frequencies in coverage areas 16 and 18 in order to receive signals from transmitters 20 and 22, respectively.

It is often difficult for a listener operating a vehicle outside of a home listening area (e.g., area 12) to discover one or more commercial radio stations that broadcast subject matter in which the listener is interested. While many in-vehicle radio receivers have a frequency scan feature, this feature often does not lock on to low power broadcast station signals, or to signals in acceptable but weak signal reception areas. Or, the scan feature locks on to a station during broadcast of an advertisement or other non-content related subject, so that the listener is unable to determine the commercial broadcast content format (e.g., rock and roll music, classical music, news) of the locked-on signal. A listener traveling in vehicle 10 who normally listens to classical music in home reception area 12 must then tune to many different frequencies in reception areas 16,18 in order to continue listening to, for example, classical music. Similarly, a listener who travels to reception area 18 and who wants to receive local information (e.g., motor vehicle traffic information for highways within area 18) will have a difficult time determining which broadcast stations within area 18 transmit such local information. It is therefore desirable to provide a way for a motor vehicle radio listener to determine what radio frequencies are available at a particular geographic location, and furthermore to identify stations that broadcast in certain subject format categories at the location.

SUMMARY

A radio signal receiving system includes a location unit, a frequency selection unit, and a receiving unit. Radio signal

tuning data is loaded into the selection unit. The tuning data includes data for tuning to particular radio signal frequencies and the reception area for each signal. The location unit determines the receiving system's geographic position and passes the position information to the frequency selection unit. The selection unit then determines in which radio signal reception areas the system is located. In some embodiments the tuning information is grouped by radio signal content categories such that the selection unit may select tunable frequencies in one or more particular content categories as the system is moved through changing signal reception areas. In some embodiments the tunable content categories, and/or information about the tunable signals, are output as a menu for listener selection. In other embodiments, tuning to receive a particular content category is automatic upon reaching a new reception area.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic plan view of several radio signal reception areas.

FIG. 2 is a diagrammatic view of an embodiment of the invention.

FIG. 3 is a diagrammatic perspective view of several satellite radio signal reception areas.

DETAILED DESCRIPTION

FIG. 2 is a functional block diagram of an embodiment of the invention. As depicted in FIG. 2, receiving system 100 is positioned in a motor vehicle, represented by dashed line 101. System 100 includes location unit 102, frequency selection unit 104, receiving unit 106, and listener interface 108.

In some embodiments location unit 102 is a conventional global positioning system (GPS) receiver that receives signals 110 from satellites in GPS constellation 112. Signals 110 include pseudo-range information that location

unit 102 uses to conventionally determine the geographic position of system 100. Information 114 identifying system 100's position is output from location unit 102 to frequency selection unit 104. In other embodiments location unit 102 determines geographic position by using corrected GPS information received from local GPS correction stations (not shown). U.S. Patent No. 5,959,577 discloses the use of GPS correction stations and is incorporated herein by reference. In still other embodiments location unit 102 determines geographic position by using conventional information in a signal received from conventional cellular wireless (radio) communications system tower 116. For example, a conventional cellular telephone handset (not shown) is electrically coupled to location unit 102 so that unit 102 receives and/or determines position information from signals transmitted by cellular communications system antenna tower 116. In this instance, system 100's location is determined to be within the signal reception area of signals transmitted from tower 116.

Selection unit 104 receives position information 114 from location unit 102. Selection unit 104 also receives frequency tuning data 120 from database 122 and stores the data 120 in conventional memory 124. Tuning data 120 is described in detail below. Various procedures are used to transfer (download) tuning data 120 from database 122 to memory 124. For example, in some instances the information is transferred using a conventional direct wired electrical connection (e.g., coupled to a computer via a cable). In other instances tuning data 120 is transferred via a conventional link through the Internet (network of interconnected networks having its origin in research done by the United States Advanced Research Projects Agency). Frequency selection unit 104 includes a conventional microprocessor/microcontroller and, as described below, uses position information 114 and tuning data 120 to select the frequency of a transmitter having a signal reception area within

which system 100 is positioned. Programming to control selection unit 104, as well as units 102, 106, and 108, is routing in light of this specification.

Selection unit 104 outputs selected frequency data 126 to receiving unit 106. In the embodiment shown in FIG. 2, conventional frequency synthesizer 128 uses data 126 so that receiving unit 106 properly tunes to receive the selected content-containing radio signal 129a. Receiving unit 106 extracts the content from signal 129a and outputs the content to the listener as audio program 129b.

In some embodiments selection unit 104 receives one or more listener commands 130 from listener interface 108. Commands 130 are made in response to selected information 132 output on interface 108, such as a broadcast subject category menu, received by interface 108 from selection unit 104.

TABLE I shows an illustrative embodiment of frequency tuning data 120. As shown in TABLE I, tuning data 120 is arranged by subject content category and by geographic area. The content categories are illustrative of many possible categories. The "xxx.x" represents one of many possible radio frequencies, such as one of the 101 available U.S. commercial FM radio frequencies. The frequencies are not limited to signals having one particular transmission form, but may refer to several broadcast forms such as commercial FM radio, AM radio, government weather reports, or other broadcast services operating in frequency spectra such as television separate audio programming or sidebands of commercial radio broadcast transmission frequencies.

TABLE I

Geo. Area	Content Category			
	Classical	Rock & Roll	Traffic	Weather
A (12)	xxx.x xxx.x	xxx.x xxx.x xxx.x	xxx.x	xxx.x
B (16)	xxx.x	xxx.x xxx.x xxx.x	xxx.x	-
C (18)	xxx.x xxx.x	xxx.x	-	xxx.x

The geographic area is the transmission signal coverage area. In some cases the geographic area is circular, centered on the broadcast antenna location, with a radius that is determined by the power of the broadcast transmitter. In other cases, such as for satellite transmissions discussed below, the circular geographic area is centered on the ground aim point of the satellite antenna. In other cases the geographic area is a more complex shape, determined for example by actual field measurement of broadcast signal reception.

As shown in TABLE I, classical music is available on two frequencies in geographic area A, rock & roll music on three frequencies, local (i.e., relevant to area A) motor vehicle traffic information on one frequency, and local weather information on one frequency. In geographic area B, classical music is available on one frequency, rock & roll music on three frequencies, local (i.e., relevant to area B) motor vehicle traffic information on one frequency, but no local weather information is available. In geographic area C, classical music is available on two frequencies, rock & roll music on one frequency, local (i.e., relevant to area C) weather information on one frequency, but no local motor vehicle traffic information is available. Particular frequencies may be listed in more than one content category (e.g., both "Rock & Roll" and "Pop Music" categories), depending on a station's particular program content format.

Referring again to FIG. 1 and continuing this example of tuning data 120, TABLE I geographic area A corresponds to broadcast reception area 12, area B to 16, and area C to 18. System 100 provides the occupant of motor vehicle 10 who wants to listen to classical music while traveling through areas 12,16,18 with classical music signal tuning information in all three areas 12,16,18. While in reception area 12, selection unit 104 (FIG. 2) outputs the two area 12 classical music frequencies as selected information 132. The listener inputs a command 130 to selection unit 104 which, in response to the command, outputs selected tuning data 126 to receiving unit 106. Receiving unit 106 then tunes to the selected frequency and outputs the signal content to the listener. Similarly, in reception area 16 the one classical music frequency is made available for selection and is output as data 126. And likewise in reception area 18, the two available classical music frequencies are made available for selection, and the selected frequency is output as data 126. Frequency tuning for the other content categories is similarly made available for selection as vehicle 10 passes through areas 12,16,18.

In some embodiments the broadcast content categories made available in frequency tuning data 120 are customized to a particular user preference. For example, a particular user accesses via the Internet a site on the world-wide-web that includes many content categories for the radio signal reception areas. The particular user selects one or more content categories of interest (e.g., classical music, local traffic information, local weather information) on the web site. The frequency tuning information is then formatted (using, e.g., a conventional server associated with the web site) and downloaded as data 120.

Available content categories are output using interface 108 as, for example, a menu of categories. In some embodiments the output is made using a conventional visual display (e.g., liquid

crystal) while in other embodiments the output is audible using a conventional audio output (e.g., synthesized or digitally recorded speech). The user then selects the content category he or she wishes to tune by using, for example, manual pushbutton inputs or verbal commands received by a conventional voice recognition system included in interface 108. This selection is output to selection unit 104 as command 130.

In some embodiments interface 108 also outputs as a menu the particular available frequencies for the reception area in which system 100 is currently located. Thus the listener may select among the available frequencies for a particular content category by using, as before, manual or verbal commands that are transformed and output as command 130. In some embodiments tuning data 120 includes a brief description giving more specific broadcast format information for each available frequency. Thus when the listener selects, for example, the rock & roll content category, interface 108 outputs to the user that one rock & roll broadcast station format is "classic rock," another station is "oldies," and still another station format is "modern rock." Thus available frequencies in one or more particular content categories may be continuously updated for listener selection.

In other embodiments, however, when system 100 leaves one signal reception area in which the listener is receiving output in a particular content category, selection unit 104 automatically selects a frequency in the same particular content category when entering the new signal reception area. Thus the listener continuously receives output in a particular content category. Tuning to new signals in some instances may be prompted by geographic position, or in other instances by received signal strength. One particularly worthwhile application of this automatic tuning feature is providing localized (e.g., within cellular communications cells near the listener's position) coverage area motor vehicle traffic

information to drivers. Drivers entering a city from one direction, for example, are typically unconcerned with traffic conditions on the opposite side of the city. Thus by using system 100 a driver may receive vehicle traffic information within, for example, 30 minutes of driving time from the present location.

Some embodiments of this invention are used to provide frequency tuning data for commercial direct satellite broadcast. Referring to FIG. 3, communications satellite 150 broadcasts on one or more radio frequencies for wide geographic reception area 151 on the surface of the earth 152. Satellite 150 also transmits three "spot" radio frequency beams aimed at different points on the earth 152. These spot beams carry, for example, information relevant to the small frequency reception area on the earth. As shown in FIG. 3, radio frequency beam 154 has reception area 156, beam 158 has reception area 160, and beam 162 has reception area 164. Reception areas 156,160 are adjacent, and so the beams 154,158 frequencies are different to prevent signal interference. Reception area 164 is distant from reception area 156, and so beams 154,162 may have the same radio frequency. Motor vehicle 10 receives tuning information for beams 154,158,162 as it travels through reception areas 156,160,164, respectively, as well as tuning information for area 151.

The present invention is not limited to the specific embodiments discussed above. For example, other embodiments may be used to provide coverage for maritime vessels or aircraft. Furthermore, embodiments are not limited to receiving audio information, but may be used to receive, for example, video, text, or information for synthesized speech output.